DECLARATION

I, Takao ENATSU, a national of Japan, c/o Asamura Patent Office of 331-340, New Ohtemachi Building, 2-1, Ohtemachi-2-chome, Chiyoda-ku, Tokyo, Japan do hereby solemnly and sincerely declare:

1) THAT I am well acquainted with the Japanese language and English language, and

2) THAT the attached is a full, true, accurate and faithful translation into the English language made by me of Japanese Patent Application No. 2002-289363.

The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001, of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 24th day of April , 2006 .

Takao Enatsu

Takao ENATSU

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[Inventor]
[Address] c/o Hitachi Research Laboratory, HITACHI, LTD., 1-1, Omikacho 7-chome, Hitachi-shi, Ibaraki, Japan.
[Name] Akira TANAKA
[Inventor]
[Address] c/o Hitachi Research Laboratory, HITACHI, LTD., 1-1, Omikacho 7-chome, Hitachi-shi, Ibaraki, Japan.
[Name] Tomoichi KAMO
[Inventor]
[Address] c/o Hitachi Research Laboratory, HITACHI, LTD., 1-1, Omikacho 7-chome, Hitachi-shi, Ibaraki, Japan.
[Name] Yasushi MURANAKA
[Applicant]
[Applicant's ID Number] 0 0 0 0 0 5 1 0 8
[Name] HITACHI, LTD.

[Agent]

[Agent's ID Number] 1 0 0 0 7 5 0 9 6

[Patent Attorney]

[Name] Yasuo SAKUTA

[Telephone] 03-3212-1111

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[Title of Invention] ELECTRONIC DEVICE USING FUEL CELL

[Claims]

[Claim 1]

An electronic device using a fuel cell, said fuel cell having a power generator panel, wherein said power generator panel takes in air through at least two wall surfaces of said power generator panel, one wall surface and the other wall surface opposite to said one wall surface.

[Claim 2]

An electronic device using a fuel cell according to Claim 1, wherein said fuel cell is detachable from said electronic device.

[Claim 3]

An electronic device using a fuel cell according to Claim 1, wherein two walls, each made of a membrane electrode assembly, of said fuel cell are exposed to air at least when power supply is turned ON.

[Claim 4]

An electronic device using a fuel cell according to Claim 1, wherein said electronic device has a display section, and said power generator panel is disposed facing said display section.

[Claim 5]

An electronic device using a fuel cell

according to Claim 1, wherein said fuel cell has a fuel tank, and can supply electric power from said power generator panel for at least ten seconds or longer from when said fuel tank is dismounted from said electronic device.

[Claim 6]

An electronic device using a fuel cell according to Claim 1, wherein said fuel cell has a power generator panel, and said power generator panel is mounted to said electronic device through the intermediary of a supporting structure and movable relative to said electronic device.

[Claim 7]

An electronic device using a fuel cell according to Claim 1, wherein there is an empty space between said power generator panel and said electronic device when power supply to said electronic device is turned ON.

[Claim 8]

An electronic device using a fuel cell according to Claim 1, wherein the distance between said power generator panel and said electronic device is shorter when power supply to said electronic device is turned OFF than when said power supply is turned ON.

[Claim 9]

An electronic device using a fuel cell according to Claim 1, wherein fuel is supplied to said power generator panel when power supply to said

electronic device is turned ON.

[Claim 10]

An electronic device using a fuel cell according to Claim 1, wherein fuel supplied to said power generator panel is stopped when power supply to said electronic device is turned OFF.

[Claim 11]

An electronic device using a fuel cell according to Claim 1, wherein said electronic device is an information electronic device comprising a main body having a semiconductor for arithmetic operation and a cover member for covering at least a part of said main body, wherein said fuel cell is switched over between a power supply state and a power stop state in conjunction with open/close action of said cover member.

[Claim 12]

An electronic device having a power generator panel, wherein the distance between said power generator panel and said electronic device differs between when the power supply state and when the power stop state of said fuel cell.

[Claim 13]

An electronic device using a fuel cell according to Claim 12, wherein a fuel supply layer is provided in a casing of said power generator panel.

[Claim 14]

An electronic device using a fuel cell according to Claim 12, wherein said power generator

panel generates electric power by taking in air through at least two wall surfaces of said power generator panel, one wall surface and the other wall surface opposite to said one wall surface.

[Claim 15]

An electronic device having a fuel cell, wherein a plurality of membrane-electrode assemblies are formed on at least two wall surfaces of said power generator panel, one wall surface and the other wall surface opposite to said one wall surface.

[Detailed Description of the Invention]

[0001]

[Technical Field Pertinent to the Invention]

The present invention relates to an electronic device having a fuel cell, and more particularly to an information electronic device using a fuel cell of a type which directly oxidizes methanol.

[0002]

[Prior Art]

Fuel cells have advantages of high energy efficiency in directly taking electric energy electrochemically from a fuel, and eco-friendly because fuel cells' emission matter is chiefly water. Therefore, attempts are being made to apply fuel cells to automobiles, distributed power supplies, and information electronic devices. Above all, for information electronic devices, fuel cells are drawing

attention as power supplies capable of long-term continuous operation to take the place of lithium batteries, and various kinds of information electronic devices are being devised which are equipped with fuel cells.

[0003]

To take examples, there are an information electronic device with a built-in fuel cell made of hydrogen storing alloy (see Patent Document 1) and an information electronic device using a methanol fuel cell (see Patent Document 2).

[0004]

Among methanol fuel cells, a type which takes electricity by direct oxidation of liquid methanol, namely, the so-called Direct Methanol Fuel Cell hereafter referred to as DMFC) has an advantage that this fuel cell does not require an auxiliary device, such as a reformer; therefore, the battery system can be formed with relative ease compared with fuel cell stacks.

[0005]

As a fuel for the cathode, oxygen is required, and normally air that includes oxygen is used.

[0006]

[Patent Document 1] JP-A-9-213359 (p.3, Fig. 1)

[Patent Document 2] JP-A-2002-49440 (p.3-4, Fig. 2)

[0007]

[Problem to be solved by the Invention]

Generally, with fuel cells, the larger cell surface, in other words, the larger electrode surface provides greater power output. However, because the size of electronic devices imposes a limit to the area of the fuel cell, the fuel cell needs to be formed in a structure that offers greater output while keeping its cubic volume unchanged.

[0008]

Therefore, according to the present invention, instead of supplying air through one side of the casing of the fuel cell to generate electricity as in the prior art, a fuel cell is used which is so structured as to supply air through at least two surfaces of the casing of the fuel cell, and supplies fuel from the inside of the casing.

[0009]

The present invention has as its object to provide a fuel cell for use on an electronic device, which is so structured as to supply air from at least two surfaces of the casing.

[0010]

[Means for Solving the Problem]

This fuel cell for use on an electronic device is not mounted in the electronic device as in the conventional design. This fuel cell is installed in such a way that an empty space where the air can enter is provided between the fuel cell and the electronic device, and that the side of the fuel cell which is

opposite to the side facing the electronic device is exposed to the ambient air.

[0011]

[Mode for Carrying Out the Invention]

(Embodiment 1)

Fig. 1 shows an external appearance of an information electronic device fitted with a fuel cell according to a first embodiment of the present invention. A fuel cell is composed mainly of a power generator panel 1 and a fuel tank 3. The fuel tank 3 is a container to store a fuel to be supplied to the power generator panel 1. The power generator panel 1 includes electrodes and an electrolyte film, and actually causes a fuel to react with oxygen to generate electric power. This power generator panel is in a flat plate, and is mounted facing the reverse side (the side without the display 12) of the display section 2 of the information electronic device 4. The information electronic device 4 may be an information device other than a notebook computer as shown in Fig. 1, or an information electronic device which has its central processing unit (CPU) and a display included in the same casing, or an information electronic device which does not necessarily require an input device, such as a keyboard.

[0012]

Fig. 1 shows a state that power is not supplied, in other words, the fuel cell set-up state in power stop mode. Fig. 2 shows the cross section of the

display section 2 and the power generator panel 1 of the information electronic device in power stop mode. In the power generator panel 1 of the fuel cell, the surface 1a (hereafter referred to as the first surface) of the generator panel on the side facing the display section of the information electronic device is in contact with the information electronic device, and the other surface (hereafter referred to as the second surface) 1b of the generator panel opposite to the first surface 1a on the side facing the display section of the information electronic device is exposed to the atmospheric air. The second surface 1b is on an extension of the surface of the casing of the display section is arranged integrally with the information electronic device. In this embodiment, the second surface 1b of the fuel cell is arranged on the extension of the surface of the casing of the display section 2 in consideration of the design in appearance. Even if the second surface 1b is not on the extension of the surface of the casing of the display section, if the rear surface 2b of the display section of the information electronic device is in contact with the first surface 1a or if rear surface 2b of the display section of the information electronic device is arranged closer to the first surface 1a of the generator panel than in power supply mode at least to such an extent as to decrease the air supply to the first surface 1a or to decrease power generation efficiency, the total size of the

information electronic device and the fuel cell combined may be made thinner and the portability may be improved.

[0013]

Fig. 3 shows a cross section of the display section of the information electronic device and the power generator panel 1 when power is supplied (in power supply mode). As is clear by comparing Figs. 2 and 3, the distance between the power generator panel and the electronic device differs between the power supply mode and the power stop mode. Here, the distance between the power generator panel and the information electronic device denotes the distance between an arbitrary point in the casing of the power generator panel and an arbitrary point in the casing of the information electronic device. In the power generator panel 1 of the fuel cell, a space is formed between the first surface 1a and the rear surface 2b of the display section, so that air can be taken in from the first surface 1a. In addition, being exposed to the atmospheric air, the second surface 1b can also take in air. In this manner, as the power generator panel 1 of the fuel cell moves, air needed to generate power can be taken in from the two surfaces of the casing of the fuel cell.

[0014]

The power generator panel 1 is mechanically supported on the information electronic device through a support member 5. The support member 5 is pulled out

slidingly in power supply mode and in power stop mode slides back to the original position in the information electronic device. In this embodiment, the support member 5 is formed by a resin frame. The support member 5 may be a metal frame or an elastic spring-type structure. The power generator panel 1 and the information electronic device 4 are electrically interconnected by a flexible cable. The power generator panel 1 is connected to a fuel tank 3 by a flexible fuel supply pipe. Thus, even if the mode changes from power stop mode to power supply mode and the power generator panel 1 moves, the electrical connection is maintained, the power generator panel 1 is supported mechanically, and also supply of fuel is also maintained.

[0015]

The power supply to the information electronic device may be limited to a fuel cell, but it may be arranged that electric power is obtained from a lithium secondary cell or an AC adapter.

[0016]

As in conventional coupling between a secondary cell and an information electronic device, the fuel cell in this embodiment is so designed as to be electrically and mechanically removable from an information electronic device. Therefore, when it is necessary to change a defective fuel cell, it is easy to perform maintenance work.

[0017]

If a fuel cell in the present invention is used to replace the existing secondary cell, the place where the existing secondary cell was mounted may be used mainly as a place to store electric connectors (not shown) to the fuel tank or the fuel cell.

[0018]

Electric connectors should preferably be designed to maintain compatibility with the secondary cell. The fuel cell comprises the power generator panel 1 and the fuel tank 3, but the power generator panel 1 and the fuel tank 3 are separable from each other. The output terminal (not shown) of the power generator panel 1 is not fixed to the fuel tank 3 but it is wired to the electric connector of the main body of the information electronic device.

[0019]

Fig. 8 is a diagram showing a cross section of the power generator panel 1. The power generator panel 1 comprises a plurality of membrane-electrode assemblies (each formed by joining together an electrolyte 8, an anode 9, and a cathode 10, and hereafter referred to as MEA). The MEAs are incorporated in the casing 11 of the power generator panel, and because the casing 11 has slits (not shown) formed in it, the cathode is partially exposed to the outside. Each MEA is supplied with fuel from a fuel supply layer 7. The fuel supply layer 7 is composed of a material capable of holding methanol as a fuel used in this embodiment. The material is desirably

a madreporite having a multitude of pores of a size capable of holding a fuel by capillary force and supplying the MEAs with a fuel. For example, a desirable material is a metal madreporite with methanol resistance, a ceramic madreporite or a carbon madreporite. Alternatively, the madreporite may be made of glass fiber. In the present invention, a madreporite made of SUS was used. The use of the fuel supply layer 7 capable of holding a fuel made it possible to supply electricity even when the fuel tank 3 was dismounted. The larger the fuel supply layer 7, the longer the power generation time becomes after the fuel tank 3 is dismounted, but with the information electronic device for which thinning the product's thickness is the important task, the thickness of the fuel supply layer is limited. In this invention, the fuel supply layer 7 was made 1mm, so that it was possible to secure a minimum time of not less than 10 seconds necessary when replacing the fuel tank 3. As has been described, according to the present invention, it has become possible to replace the fuel tank while electric connection between the power generator panel 1 and the information device is maintained.

[0020]

The fuel tank 3 is mounted on top of the power generator panel 1. The fuel is supplied from the fuel tank 3 by using gravity and capillary force. Besides the top of the power generator panel 1, the fuel tank 3

may be placed at the installation location for the conventional secondary cell below the power generator panel 1, in other words, under the palm rest or at the edge portion of the main body of the information electronic device. In this case, fuel transportation from the fuel tank may be by capillary force or by a small pump (not shown) built in the information electronic device.

[0021]

The connectors for electric connections are preferably provided also for a system to transmit information about the remaining amount of the fuel in addition to a system to supply electric power required to drive the information electronic device. In all cases, those connectors should be provided for the same kinds of systems as when a secondary cell was used. At least one or more systems should be dedicated to supply of power and it will be all very fine if multiple systems are provided to supply power to the drive parts in the information electronic device. It is preferable to provide a part, such as a DC/DC converter, to change electric power produced by the generator panel 1 to a voltage suitable for the information electronic device, and also provide a super capacitor or an ultra capacitor to compensate for instantaneous power.

[0022]

Also, it is possible to provide power supplies other than the fuel cell, a secondary cell, for example,

for use as an auxiliary power supply for starting the information electronic device, or a power supply power supply for monitoring specific events.

[0023]

As shown in Fig. 4, when the power switch of the information electronic device is turned ON, the power supply mode is detected, the power generator panel 1 of the fuel cell separates from the main body of the information electronic device, thereby forming a space to supply air from, and the supply of fuel is started. The method by which the power generator panel 1 of the fuel cell is made to separate from the main body of the fuel cell may be electrical or mechanical or manual. It poses no problem if the information electronic device enters a start-up state when the power generator panel 1 of the fuel cell is opened manually. With information electronic devices other than those driven solely by a fuel cell, for example, an information electronic device, which can be connected to a fuel cell and a secondary cell or the like, is preferably provided with a function to make a decision whether it is connected with an AC adapter, or a conventional secondary cell or a fuel cell, and so on, when the power switch is turned ON.

[0024]

To stop the information electronic device, the power switch is turned OFF, at which the power stop mode is detected, and after a specified termination process

is finished, the power generator panel 1 of the fuel cell returns to the former position, namely, into the state shown in Fig. 2, and is substantially in one body with the main body of the information electronic device, and the supply of fuel is stopped. Here, "substantially in one body" means that they appear to be a single body. The method by which the power generator panel 1 of the fuel cell is brought to the former position may be electrical or mechanical or manual. When the power generator panel 1 of the fuel cell is brought manually to the former position, the information electronic device may enter the power stop mode.

[0025]

With the current state of technology, it is difficult for an electrolyte as a component of the MEA to completely block the transmission of methanol. For this reason, if a fuel, such as methanol, directly contacts the power generator, the fuel is consumed even if the information electronic device 4 is not operating. Therefore, in the present invention, the supply and stoppage of the fuel is linked with the power supply mode or the power stop mode, and consumption of fuel such as methanol while the information electronic device 4 is inoperative is minimized and thereby the fuel is saved, namely, a substantially prolonged operation is made possible. If, by improvement of the electrolyte film, the transmission of fuel, such as methanol, can be blocked or substantially reduced, it is not always

necessary to link supply or stoppage of fuel with the power supply mode or the power stop mode.

[0026]

The power generator panel 1 of the fuel cell in power supply mode is not necessarily required to be in parallel with the display section 2 of the information electronic device. The power generator panel may be inclined to facilitate dissipation of steam produced.

[0027]

This embodiment uses a DMFC for the fuel cell, but the fuel cell is not limited to this type. A wide range of fuel cells, such as PEFC, may be used as long as the structure of the fuel cell is such that air is taken from at least two surfaces of the casing of the fuel cell. The reason for "at least" mentioned above is as follows. Firstly, a structure is conceivable which has an MEA as an air-inlet passage mounted at the end face of the power generator panel 1 other than the first surface 1a and the second surface 1b, and secondly, its structure is not necessarily a rectangular body but may be polygonal in cross section.

[0028]

In this embodiment, the fuel is not limited to methanol, but it is possible to use hydrogen or a gas containing hydrogen.

[0029]

(Embodiment 2)

Fig. 5 shows a sectional view of the fuel cell and the display section 2 of an information electronic device fitted with the fuel cell according to a second embodiment of the present invention. The fuel cell comprises a fuel tank 3 and a power generator panel 1, and the fuel tank 3 and the power generator panel 1 are put together as one body. The fuel cell can be dismounted from the information electronic device 4. When in power supply mode, the information electronic device is fitted with a fuel cell, and when in power stop mode in which the information electronic device 4 is not used, such as in transit, the fuel cell is dismounted from the information electronic device 4, and therefore the information electronic device becomes thinner, and its portability improves.

[0030]

The power generator panel 1 is in a flat plate, and is mounted at the rear side 2b of the information electronic device in a manner facing the flat display section 2. A projection 6 is formed at a part of the casing of the fuel cell to provide a space between the information electronic device 4 and the fuel cell. This projection may be provided on the information electronic device side.

[0031]

In the power supply mode in which the fuel cell is mounted, in the power generator panel 1 of the fuel cell, the first surface 1a is not substantially in

contact with the information electronic device, and the second surface 1b is exposed to the atmospheric air and therefore, air can be taken from those two surfaces.

[0032]

The fuel cell is formed by combining the fuel tank 3 and the power generator panel 1 in a single body, with the result that the fuel cell is simplified in structure, and made easy to manufacture, so that price can be reduced.

[0033]

(Embodiment 3)

Fig. 6 shows a schematic cross section of the display section of the information electronic device fitted with a fuel cell and the fuel cell in the power supply mode according to a third embodiment of the present invention and the fuel cell in power supply mode. In the stop mode in which power is not supplied, as shown in Fig. 1 of the first embodiment, the power generator panel 1 of the fuel cell is in contact with and in one body with the information electronic device. When the power switch is turned ON, the power supply mode is detected, the power generator panel 1 of the fuel cell separates from the information electronic device 4, by which a space is formed to supply air to the MEAs, and the fuel begins to be supplied. As regards the shape of the space to supply air to the power generator, as shown in Fig. 6, the power generator panel 1 of the fuel cell bends at least one or more

points of it in a so-called accordion-fold. The mechanism of this bending may be electrical, mechanical or manual as in the first embodiment. When the power generator panel 1 of the fuel cell is moved away manually, the information electronic device may enter a start-up state. The direction in which the panel bends may be in the horizontal direction other than in the vertical direction as shown in Fig. 6. When the information electronic device 4 is stopped, the power switch is turned OFF as in the first embodiment, at which the power stop mode is detected, and when a specified termination process is finished, the power generator panel 1 of the fuel cell returns to the former position, comes into contact with the information electronic device main body, and the supply of fuel is stopped.

[0034]

The method by which the power generator panel 1 of the fuel cell is brought to the former position may be electrical, mechanical or manual. When the power generator panel 1 of the fuel cell is manually brought to the former position, the information device may enter a power stop mode. Even if the information electronic device is toppled over inadvertently in power supply mode, because the power generator panel 1 of the fuel cell bends in an accordion-fold, it is less likely to be damaged than the power generator panel structured in a single flat plate.

[0035]

(Embodiment 4)

Fig. 7 is a schematic cross section showing the display section 2 of the information electronic device 4 fitted with a fuel cell and the fuel cell in the power supply mode according to a fourth embodiment of the present invention and the fuel cell in power supply mode. In the stop mode in which electric power is not supplied, the power generator of the fuel cell is substantially in one body with the information electronic device as shown in Fig. 1 of the first embodiment. When the power switch is turned ON, the power supply mode is detected, the power generator panel 1 of the fuel cell slides up beyond the information electronic device to thereby obtain a space to supply air to the first surface 1a of the power generator panel 1, and the fuel begins to be supplied. The fuel tank 3 is incorporated in the information electronic device 4, and a small pump is used to supply a fuel to the power generator panel 1 through a flexible fuel supply pipe. Besides a single flat panel type, the power generator panel 1 may be structured such that a flat panel consists of strips which are folded in power supply mode, and the panel unfolds into a single flat panel when power is supplied. As has been described, instead of in the through-thickness direction of the display section of the information electronic device, the power generator panel 1 extends in the vertical direction of

the display section, so that the information electronic device can maintain its thinness even when it is operative.

[0036]

[Effect of the Invention]

According to the present invention, an electronic device fitted with a fuel cell can be provided which is so structured as to supply air from at least two surfaces of the casing for better energy efficiency.

[Brief Description of the Drawings]

[Fig. 1]

A diagram which shows an external appearance of an information electronic device fitted with a fuel cell according to a first embodiment of the present invention.

[Fig. 2]

A diagram which shows a cross section of the display of the information electronic device in a power stop mode.

[Fig. 3]

A diagram which shows a cross section of the display of the information electronic device in a power supply mode.

[Fig. 4]

A flowchart for explaining the relation between states of a power supply switch of the

information electronic device and operations of the fuel cell.

[Fig. 5]

A diagram which shows a schematic cross section of the fuel cell and the display section of an information electronic device fitted with the fuel cell according to a second embodiment of the present invention.

[Fig. 6]

A diagram which shows a schematic sectional view of a display section of an information electronic device fitted with a fuel cell according to a third embodiment of the present invention and the fuel cell in power supply mode.

[Fig. 7]

A diagram which shows a schematic cross section of a display of an information electronic device fitted with a fuel cell according to a fourth embodiment of the present invention and the fuel cell in power supply mode.

[Fig. 8]

A schematic diagram which shows a cross section of the fuel cell adopted in the present invention.

[Description of Reference Numerals]

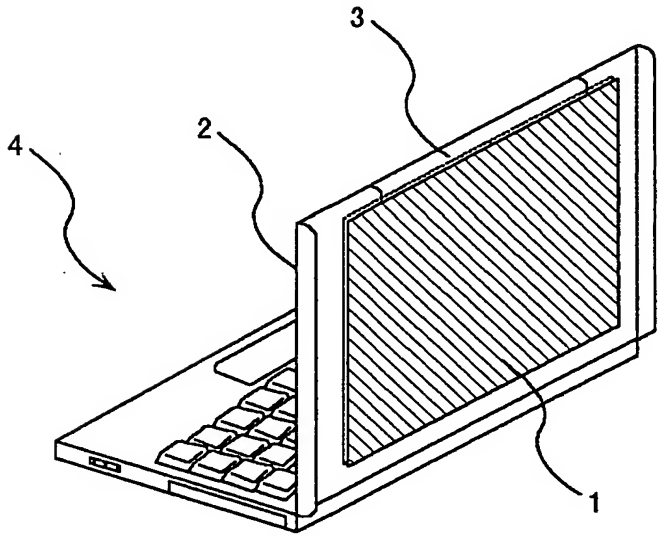
1 ... Power generator panel, 1a ... Surface of the power generator panel on the side facing the display

section of the information electronic device, 1b ... Surface of the power generator panel on the side opposite to the side facing the display section of the information electronic device, 2 ... Display section, 2b ... Rear surface of the display section of the information electronic device, 3 ... Fuel tank, 4 ... Information electronic device, 5 ... Support member, 6 ... Projection, 7 ... Fuel supply layer, 8 ... Electrolyte film, 9 ... Anode, 10 ... Cathode, 11 ... Casing of the power generator panel

【書類名】　図面　〔Kind of Document〕 Drawings

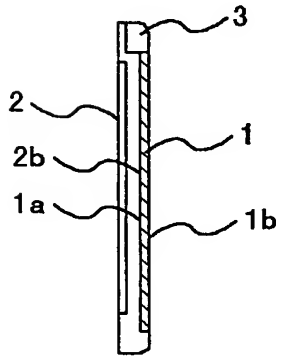
【図１】　〔Fig. 1〕

図　1　Fig. 1



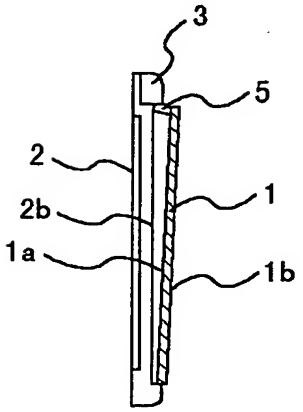
【図２】　〔Fig. 2〕

図　2　Fig. 2



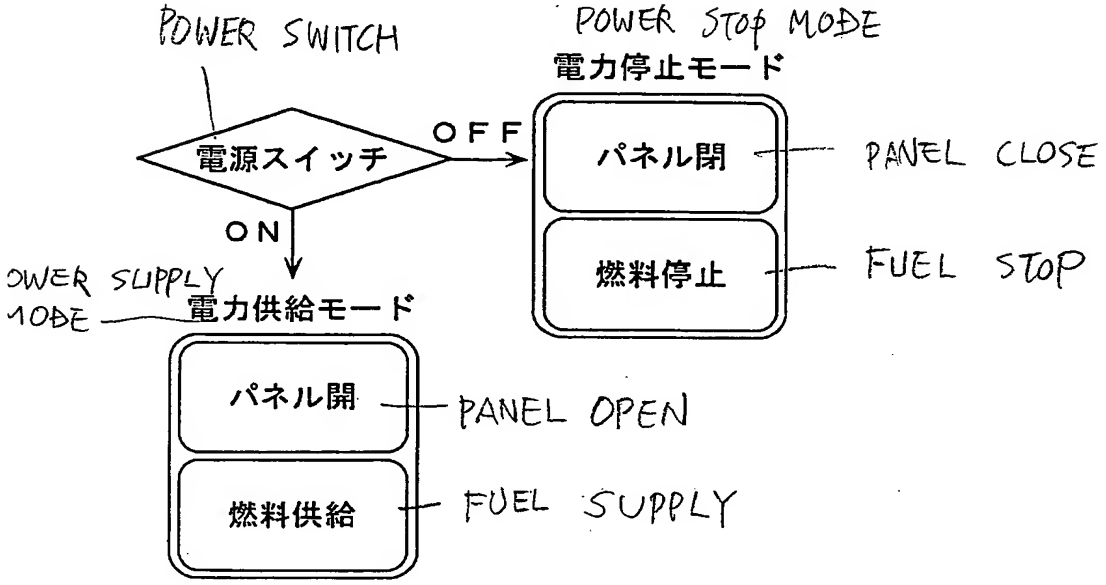
【図３】　〔Fig. 3〕

図　３　　Fig. 3



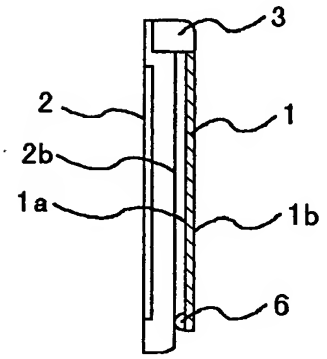
【図４】　〔Fig. 4〕

図　４　Fig. 4



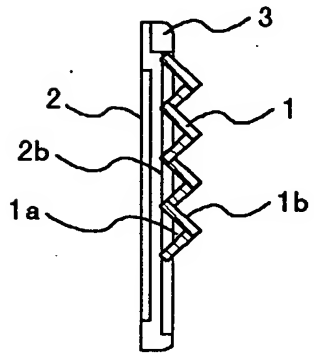
【図５】　〔Fig. 5〕

図　５　　Fig. 5



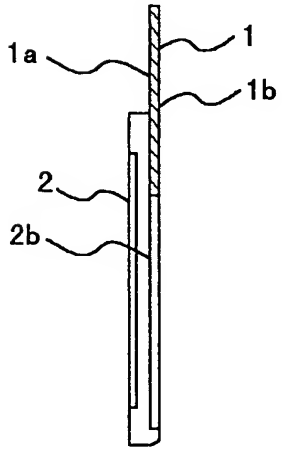
【図６】　〔Fig. 6〕

図　６　　Fig. 6



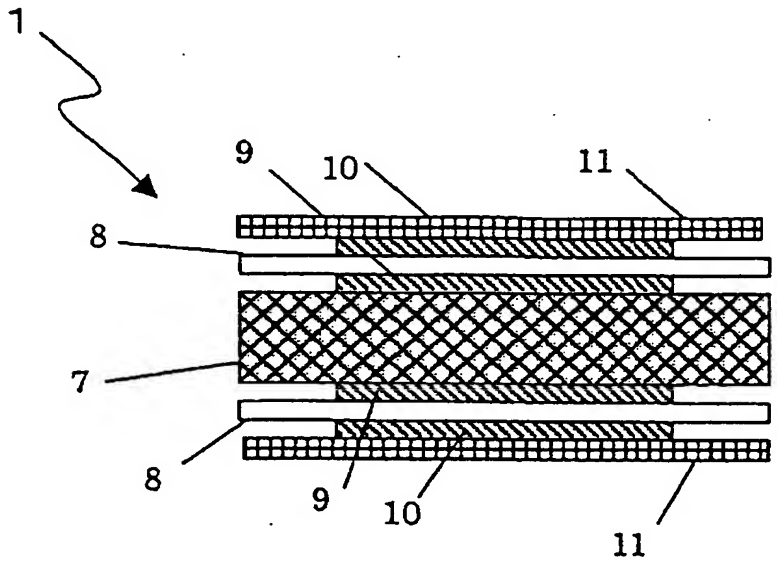
【図７】　〔Fig. 7〕

図　７　　Fig. 7



【図８】 〔Fig. 8〕

図　８　Fig. 8



[Kind of Document] Abstract

[Abstract]

[Problem]

An electronic device having a fuel cell is provided, which is characterized by the structure formed to introduce air from at least two surfaces of the casing of the fuel cell and to supply a fuel from the inside of the casing for improved energy efficiency.

[Solution]

The fuel cell to be mounted on the electronic device is not mounted in an electronic device as in prior art, but the fuel cell is structured to form an air-supply space between the fuel cell and the electronic device and mounted in a manner that the outer surface of the fuel cell on the side opposite to the side facing the electronic device is exposed to the ambient air. According to the present invention, it is possible to provide an electronic device fitted with a fuel cell structured to supply air from at least two surfaces of the casing to achieve better energy efficiency.

[Selected Figure] Figure 3